

Fungal and bacterial diseases of cardamom (*Elettaria cardamomum* Maton) and their management

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ABSTRACT

Small cardamom (*Elettaria cardamomum*) is susceptible to a number of diseases due to fungi, bacteria and viruses. Twenty six different types of diseases have been reported of which only a few have been considered as major causing severe crop losses. The major diseases of fungal origin are 'azhukal' (capsule rot) caused by *Phytophthora meadii*, rhizome rot (clump rot) and seedling rot (damping off) caused by *Phythium vexans*, leaf blight caused by *Phytophthora meadii*, leaf blotch caused by *Phaeodactylum alpiniae* and leaf spots by *Cercospora* sp., and *Sphaceloma cardamomi*, leaf rust by *Phakospora elettariae*, brown spot by *Colletotrichum gloeosporioides* etc. Most of the diseases occur during the South West monsoon period where heavy rain coupled with high relative humidity predisposes the plant to infection. Since the occurrence and spread of diseases are correlated to weather conditions, integrated disease management strategy adopting cultural, chemical and biological control methods are highly suitable to save the crop from heavy losses.

Key words: cardamom, control measures diseases, *Elettaria cardamomum*.

In India, small cardamom (*Elettaria cardamomum* Maton) is cultivated in an area of about 90,000 ha producing an average of 5000 to 6000 t annually. Damages due to pests and diseases, decline in suitable forest areas for cultivation, frequent occurrence of unfavourable climatic conditions such as floods, cyclones and droughts are some of the important constraints in cardamom production in India.

Cardamom is affected by a number of diseases caused by fungal and viral pathogens of which only the former is dealt here. The disease problems of cardamom have earlier been reviewed (Nambiar, Pillai & Nambiar 1975). Although 26 different types of diseases caused by fungal and bacterial pathogens are detected, only a few are considered as major, resulting in severe crop damage.

Major diseases

Major fungal diseases causing considerable crop loss are 'azhukal' (capsule rot), rhizome rot (clump rot), seedling rot (damping off), leaf blight, leaf blotch and nursery leaf spots.

'Azhukal' or capsule rot

'Azhukal' is a serious problem and a major constraint in the successful cultivation of cardamom in Kerala where almost 69 per cent of the crop is grown. The disease is locally known as 'azhukal' which means rotting.

History and distribution

'Azhukal' disease was first reported by Menon *et al.* (1972) from Idukki District of Kerala. Since then it is frequently observed in Idukki and Wynad districts of Kerala and in isolated pockets of Anamalai hills in Tamil Nadu. A crop loss of 30 per cent has been estimated by Nambiar & Sarma (1976). However, during years of heavy and continuous rainfall, as high as 40 per cent crop loss has been reported (ICRI 1989). Menon *et al.* (1972) reported that it is caused by a species of *Phytophthora* while Thankamma & Pillai (1973) identified it as *P. nicotianae* var. *nicotianae*. Nambiar & Sarma (1976) reported the involvement of *Pythium vexans* with 'azhukal' disease. Nair (1979) isolated *P. nicotianae* var. *nicotianae* invariably from all infected parts of cardamom. Recent studies revealed that *P. meadii* Mc Rae of A2 mating type is the pathogenic fungus responsible for 'azhukal' disease (ICRI 1986).

Symptoms

The disease appears during South West monsoon season in the form of water soaked lesions on tender leaves and capsules, which later form dead areas

surrounded by yellow halo and the leaves rot and shred along the veins. In advanced stages, the infection spreads to panicles and tillers and in extreme cases the rhizomes also rot and the entire plant perishes. Immature capsules rot and fall off emitting a foul smell. Mature capsules when infected become shrivelled on drying. Joseph, Suseela Bhai & Naidu (1991) observed that symptoms of rotting appear simultaneously on capsules and tender leaves or first on capsules followed by on foliage. Plants of all ages are infected; however under field conditions, disease incidence is noticed mainly on bearing plants.

Epidemiology

Menon *et al.* (1972) noticed a high incidence of the disease during months of heavy and continuous rainfall while Nair & Menon (1982) observed that during July - August with heavy rainfall and high relative humidity, the soil population levels of *Phytophthora* was at its peak with a high incidence of 'azhukal'. Thick shade and close spacing together with favourable climatic conditions predispose the plants to infection. *Phytophthora* survives in soil in the form of hyphae and sporangia for 4 to 6 weeks while as chlamydospores, it can survive as long as 48 weeks in moist soils.

Manomohan & Abi Cheeran (1984) studied the host range of *P. palmivora* isolated from cardamom from Wynad and reported its crop infectivity to coconut, arecanut, cocoa, black pepper and rubber. Sasthry & Hedge (1989) isolated *P. meadii* from cardamom which readily infected cocoa, black pepper and citrus except arecanut, whereas *P. meadii* from arecanut and cocoa were infective to cardamom and all other

hosts tested. *P. palmivora* isolates from rubber and coconut were cross infective to cardamom (Radha & Joseph 1974).

Disease management

Early detection of the disease and timely plant protection measures are important in managing the disease. The use of fungicides such as Bordeaux mixture, copper oxychloride etc. has earlier been reported to control the disease (Menon *et al.* 1973; Nambiar & Sarma 1974; Joseph, Suseela Bhai & Naidu 1991).

Since the occurrence and spread of 'azhukal' disease is directly correlated to weather conditions, an integrated disease management strategy involving plant sanitation, chemical and biological methods is more suitable. Plant sanitation including removal and destruction of diseased plant parts and regulation of shade in plantations are to be carried out before the onset of monsoon. The first round of prophylactic fungicidal application should be done before the onset of monsoon, usually in May. Since water stagnation aggravates disease severity, better drainage in the plantation should be assured. Plant sanitation coupled with timely application of Bordeaux mixture (1%) or systemic fungicides such as Aliette (0.3%), two to three times per year effectively controls the disease (Joseph, Suseela Bhai & Naidu 1991).

Biological control of *P. meadii* infections using antagonistic fungi such as *Trichoderma* spp. and *Laetisaria* sp. has been found effective in managing 'azhukal' disease (Suseela Bhai, Joseph & Naidu 1992). Attempts have also been initiated in managing the disease using antagonistic plant products. Dhanapal, Joseph & Naidu (1993) reported that

neem and garlic extracts were effective in inhibiting rot pathogens and suppressing the disease to a considerable extent.

Rhizome rot

Rhizome rot is one of the earliest noticed fungal disease occurring in Kerala and Karnataka, and is also called as clump rot disease (Mayne 1942).

Symptoms and damage

The disease appears as yellowing of foliage, followed by drooping of leaves; collar region becomes brittle which breaks off at slight disturbance. As the disease advances, rotting starts at collar region and extends to the rhizomes and roots and the affected tillers later fall off. Rhizome rot and shoot lodging are severe during monsoon season. In seedlings the disease is called as damping off. The seedlings die and collapse in masses. In secondary nurseries of 6-18 month old seedlings, the type of symptoms are similar to those in mature plants. In nurseries, the disease incidence varies from 10 to 60 per cent. Ali & Venugopal (1993) reported the incidence of this disease as high as 64.5 per cent in some nurseries in Karnataka.

Causal organisms

Soil borne pathogenic fungi, *Pythium vexans* and *Rhizoctonia solani* are the causal organisms of rhizome rot disease both in older plants and seedlings, Siddaramaiah (1988) reported that *Fusarium oxysporum* also causes seed and seedling rot.

Disease management

Control of damping off in nursery seedlings following pre-treatment of nursery beds with formaldehyde (0.2%) (Pattanshetty, Deshpande & Shivappa

1973) and effect of fungicides in disease control has been reported earlier (Pattanshetty, Deshpande & Shivappa 1974). Joseph, Naidu & Suseela Bhai (1968) reported that fungicides such as Mancozeb and Brassicol (PCNB) were effective for disease control.

Antagonistic *Trichoderma* spp. and *L. arvalis* were effective in controlling the diseases in nursery and plantations, (Joseph *et al.* 1993 a & b). Dhanapal, Joseph & Naidu (1993) reported that neem seed extract (neem gold) and garlic extract greatly reduced disease incidence.

Leaf blight

In recent years leaf blight caused by foliar infections by *P. meadii* is gaining importance (ICRI 1986). The disease appears after monsoon, becomes severe during winter season (November to February) and declines by March. The symptoms develop as brownish spots and patches on the leaf lamina, often extend to large continuous areas and finally these portions or the entire affected leaves shred and dry. The disease is found only in certain localities. It has been observed that continued mist formation in plantations favours the incidence and spread of the disease. The disease can be controlled by one or two rounds of Bordeaux mixture spray.

Leaf blotch

Agnihotrudu (1968) reported a leaf disease characterized by water soaked lesions which develop as enlarged blotches during rainy season. The causal organism was identified as *Phaeodactylum alpiniae*. During wet season, lesions develop at the tip or near the leaf midribs which turn necrotic brown. The mycelium and conidial

masses of the fungus are visible as thick grey coloured mats or powdery coatings on the underside of the blotched area. During dry weather, infection is restricted to smaller lesions. In such cases the mycelium is not visible and the spread of the disease is also restricted. Fungicides such as Bordeaux mixture, copper oxychloride (Nair 1979; Ali 1982), Mancozeb or Hinosan (ICRI 1986) as foliar spray were effective for the control of the disease.

Leaf spots

Occurrence of various types of leaf spots caused by a variety of fungal pathogens has been reported by several workers.

Sphaceloma leaf spot

Muthappa (1965) observed small scattered spherical blotches leading to large necrotic patches. The pathogen was reported as *Sphaceloma cardamomi*. Naidu (1978 a) reported Ceylon Erect and Alleppey Green cultivars of cardamom as resistant to the disease.

Cercospora leaf spot

A leaf spot prevailing in Coorg area was reported on Malabar, Bengal and Assam cultivars of cardamom (Rangaswami, Seshadri & Lucy Channama 1968). It is seen both in nurseries and plantations. The symptoms appear on the foliage as rectangular or linear lesions which are muddy red in colour running along and bound by the veins, 0.5 to 2 mm wide and of varying lengths. The upper side of the lesions is dark brown in colour with less defined margin. A number of such spots are formed on the leaves. The disease is caused by *Cercospora zingiberi* which produces conidiophores in clusters with few conidia which are linear and 3-6 septate.

Glomerella leaf spot

Nair (1979) reported circular or ovoid dark brown concentric spots on the leaf 1-2 mm in length which enlarge and develop to brown coloured spots with depressed necrotic centers. Later, alternate concentric dark and pale brown bands develop with an yellow halo around the entire spot. A number of such mature spots coalesce to form large patches up to 4 cm in diameter. The pathogen was identified as *Glomerella cingulata* which produces perithecia in the form of dark dot like structures embedded in the lesion area.

Leaf spots caused by *Phaeotrichoconis crotalariae* (Dhanalakshmy & Leelavathy 1976) and *Cercospora elettariae* (Ponnappa & Shaw 1978) occur rarely on cardamom leaves. *Phaeotrichoconis* leaf spot appears on young and old leaves both under dry and wet conditions as papery white irregular areas with brown margins. During dry weather, the central portions dry and break off.

Leaf blight caused by *Alternaria* sp. is observed rarely in young seedlings. It appears in the form of desiccated areas on the foliage which later show symptoms of wilting. It is manageable through the use of fungicides such as Mancozeb.

Leaf rust

Thirumalachar (1943) reported the incidence of rust disease from Mysore. The disease appears after monsoon rains during October to May. The symptoms appear as small pin head white pustules on leaves which later become rusty brown in appearance. Many such pustules formed in clusters are surrounded by a broad yellow halo. It is caused by *Phakospora elettariae*. In recent years

widespread incidence of leaf rust has been observed in lower Pulney areas of Tamil Nadu (1978 b). Naidu (1978 b) reported a hyperparasitic fungus *Darluka filum* which develops during advanced stages of infection and prevent the secondary spread of the rust pathogen.

Chenthall or bacterial blight

Mathew, Potty & Jayasankar (1976) reported the occurrence of a leaf blight disease caused by the gram positive rod shaped bacterium viz., *Corynebacterium* spp. from Vandanmedu areas (Kerala). The disease was locally known as 'chenthall'. The symptoms of the disease appear as elongated water soaked lesions on the abaxial surface of young leaves. In advanced stages, the lesions become brown to dark brown with a pale yellow halo. The leaves wither resulting in wilting of pseudostems. The disease affected gardens present a burnt appearance. Flowers produced after disease incidence fail to form capsules.

Mathew & Jayasankar (1977) reported the association of *Corynebacterium* with the disease and also reported that spraying with penicillin controls the disease. However, detailed investigations carried out in later years showed that *Colletotrichum gloeosporioides* is the pathogen responsible for the disease. The penicillin therapy reported to control infections due to *Corynebacterium* sp. is also not fruitful and practicable at the field level.

Several *Colletotrichum* leaf spots leading to blight similar to the so called 'chenthall' is a common occurrence in cardamom plantations which are exposed to direct sunlight. The disease is aggravated during summer season. Providing adequate shade in the plantation

and mulching the plants to conserve soil moisture etc. ensure disease control to a certain extent. Mancozeb was found to limit the further spread of infection.

Sooty mould

A sooty mould identified as *Triposporiopsis* sp. was found to infect the leaves of plants grown under the shade tree 'chandana vayambu' (*Cedrella toona*) (Nair 1979). The mycelium, dark brown to black infects and spreads over the lamina and petioles and extends to the tillers. Siddaramaiah (1988) reported sheath and leaf rot caused by *Sclerotium rolfsii*.

Minor diseases on capsules

In addition to foliar diseases, a number of fungi cause various minor diseases on capsules. *Fusarium* capsule rot caused by *F. moniliforme* (Wilson, Sasi & Mathew 1974) is characterized by rotting of the distal portions of capsules. A similar but severe infection called tip rot is observed in plantations in Karnataka in recent years caused by *Rhizoctonia solani*. Anthracnose or brown spot caused by *C. gloeosporioides* is also reported to occur in recent years (Suseela Bhai, Joseph & Naidu 1988). Diseases of uncertain etiology such as development of white spot and patches, ring spots, canker like protrusions etc. on capsules are frequently observed. Agnihothrudu (1974) mentioned the possibility of a bacterium viz., *Xanthomonas* sp. on the rind of cardamom capsules causing canker like symptoms. However this has not yet been established beyond doubt. As no conclusive evidence was obtained or pathogenicity proved, the question of occurrence of a bacterial disease in cardamom needs further investigation.

Stem lodging

A new disease producing lesions on the pseudostems leading to dry rotting and lodging of tillers was recently observed in several cardamom areas. The pathogen was identified as *Fusarium oxysporum*. The disease occurs during the post monsoon periods.

Browning disease

Reddish brown patches on the capsules and panicles were found in certain areas. Pathogenic fungi such as *C. gloeosporioides*, *Aphanomyces* etc. are associated with the disease, but the pathogenicity of the former only has been proved.

Mayne (1942) observed this disease and found that it is caused by *Phyllosticta* sp. Chowdhary (1948) later described the fungus as *P. elettariae*. The disease symptoms develop on the leaves of young seedlings as whitish round spots which later turn papery white with a hole in the center. The disease is more severe and widespread in nurseries in Karnataka. In severe cases, rotting of leaves is also observed followed by reduced tillering. Spraying with Difolatan (0.2%) is effective in managing *Phyllosticta* leaf spots (Rao & Naidu 1974).

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